Report for 2002LA5B: Groundwater Contaminant Transport Following Flooding Events: Impacts of Model Size, Resolution, and Complexity

There are no reported publications resulting from this project.

Report Follows:

SYNOPSIS

Problem and Research Objectives

In spite of numerous safeguards and precautions, there exists a potential for accidental release of contaminants during and following flood events. Sources for contamination include ruptured or damaged pipelines, storage tanks and water/wastewater treatment facilities. While some of the contaminant is expected to be transported by the surface water during the event, a portion of the release may enter the subsurface through infiltration, or if the chemical is denser than water, it may sink directly into the ground. This contaminated groundwater can potentially impact the natural habitat, water wells, or surface water bodies.

Numerical modeling of groundwater flow and solute transport is constrained by the required computational time and available data. In addition, risk or dose assessments require the simulation of many contaminants under multiple scenarios. Thus, choices must be made concerning the model domain, mesh resolution, and model complexity. The overall objective of this research is to develop a better understanding of these issues in scenarios where a release has occurred following a flooding event that results in subsurface contamination.

This project is continuing work by the PI's research group toward incorporating uncertainties into groundwater flow and transport models and the use of telescopic mesh refinement (TMR) for constructing localized, high resolution models within regional models. Contaminant transport scenarios are typically localized and require fine mesh spacing---TMR allows investigators to develop these high-resolution models within large site-wide or regional models. This allows for the larger scale processes and dynamics to be incorporated into the fate and transport models without having a high-resolution, and computationally-expensive, regional model. In addition, smaller-scale modeling domains are amenable to techniques that allow for the quantification of uncertainty. While able to incorporate more of the processes that control fate and transport, complex models can be computationally expensive and require the identification and quantification of multiple parameters. Simple models are computationally efficient, require fewer parameters, and are much easier for decision-makers to understand.

Regardless of the source, once in the subsurface, contaminant fate and transport will be effected by complex physical, chemical, and biological processes. A proper risk assessment (before any release) or site assessment (after a release) requires an understanding of the spatial and temporal variabilities inherent in the natural systems and their impact on the fate and transport. The results from this project will guide us towards the development of better modeling techniques and strategies for assessing the impacts of contaminant releases following flooding events.

Methodology

When dealing with contaminant flow and transport modeling, there are a variety of approaches available. The model used depends on the amount and quality of the information/data available and the type of contamination event. For multiphase scenarios (e.g., leaking underground storage tanks, DNAPLs, etc…), complex multiphase, multicomponent models are available to simulate the release, flow of free phase product, and subsequent groundwater transport. However, these models require a large investment in user training and a significant amount of data. Simpler models (e.g., Hydrocarbon Spill Screening Model) are available to provide order-of-magnitude estimates of groundwater contamination. A variety of models are also available for scenarios where only the contaminant transport is to be modeled.

There are complex models that are capable of incorporating multiple chemical and biological reactions (e.g., RT3D) and simple models that can be run using a spreadsheet (e.g., BIOSCREEN).

The first step is to identify the various sources of contamination within the study area. This includes information on the location, volume, and chemical/contaminant composition. The next step is to obtain, organize, and analyze information concerning the hydrogeology within the study area. This includes both geological and hydrological data. All of this data and information will be combined into a Geographical Information System (GIS), which will allow for the development of the various "conceptual" models that will be used to investigate groundwater contamination.

Project Status

The data and information on the location, volume, and chemical/contaminant composition of the all the underground storage tanks in the New Orleans Area has just been compiled and put into a GIS format. We are currently compiling the hydrogeological data from the region. As mentioned above, this project has been granted an extension. Work will continue on this project over the next year.